Review Article

Bridging the Care Gap: A Nursing Perspective on Integrating Voice-Enabled Virtual Nurse Assistant to Enhance Patient Self-Efficacy and Mitigate Workforce Strain

[1]Komakula NKS Santhoshi, [2]Avanthi Devi P, [3]Veena V G, [4]Vikas M Miskin

[1-4]Nursing Tutor / Clinical Instructor, College of Nursing, All India Institute of Medical Sciences (AIIMS), Mangalagiri, Andhra Pradesh, India

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Abstract

Rapid digital transformation across industries has accelerated the adoption of advanced technologies to reduce manual workload, enhance efficiency, and optimize operational costs. Healthcare is undergoing a similar transformation, with artificial intelligence (AI) emerging as a key enabler of innovative care delivery modelsa. Among these, Voice-Enabled Virtual Nursing Assistants (VNAs) represent a promising solution to address increasing care demands, workforce shortages, and rising healthcare costs.

Virtual Nursing Assistants offer 24/7 availability, enabling continuous patient engagement beyond the limitations of human staffing. They assist patients by responding to health-related queries, providing medication reminders, monitoring symptoms, supporting chronic disease management, and offering emotional and mental health support. Evidence suggests that VNAs improve accuracy, timeliness, and accessibility of care compared to traditional methods.

From a healthcare provider perspective, VNAs streamline documentation, support preliminary assessment and triage, enhance real-time monitoring, and optimize workflow efficiency. In critical care settings, the integration of virtual nursing roles has been identified as a viable approach to mitigating projected nursing workforce gaps while maintaining care quality. Additionally, VNAs demonstrate potential in education and staff development through virtual teaching platforms and cognitive learning enhancement.Future advancements are expected to expand VNA capabilities through wearable integration, electronic health record synchronization, advanced personalization, and diagnostic support. Despite challenges related to data security, ethics, cost, usability, and regulatory frameworks, Virtual Nursing Assistants represent a transformative digital health innovation with significant potential to improve patient outcomes, empowers especially elderly patients and reducesnurse's workload, and strengthen healthcare systems.

Keywords: Virtual Nursing Assistant, Artificial Intelligence in Healthcare, Digital Health Transformation, Voice-Enabled Technology, Patient-Centered Care, Nursing Workforce, Healthcare Automation, Geriatric Care.

Corresponding Author: Komakula NKS Santhoshi, Nursing Tutor / Clinical Instructor, College of Nursing, All India Institute of Medical Sciences (AIIMS), Mangalagiri, Andhra Pradesh, India

E-mail: santhuswarupa@gmail.com

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Introduction

Almost every industry sector is undergoing digital transformation. To reduce manual workload and slash operational costs, organizations rely on new-age technologies. Most organizations are moving towards hyper-automation, where the human touch is minimal. One industry sector undergoing significant digital transformation is healthcare. AI tools for digital transformation in healthcare are no longer a far-fetched idea. eHealth and mHealth lifestyle tools such as AI-powered chatbots have emerged, promising affordable, scalable interventions to empower patients and to reduce workload over health care providers.[1]The use of artificial intelligence in healthcare has immense potential. Healthcare providers are constantly striving to improve patient care and streamline their operations. A virtual nursing assistant is not a human; it is a device or robotic system designed to assist individuals with healthcare-related needs[2]. Voice-Enabled Virtual nursing assistants can bring a paradigm shift to patient care and at the same time Virtual Nursing Assistant improve overall operational efficiency and reduce costs for both healthcare facilities and patients.Implementing a virtual nursing role in the intensive care unit offers a viable approach to addressing projected gaps in nursing workforce capacity and quality.[3]

Need for Virtual Nurse Assistance

A healthcare provider cannot be available for a single patient around the clock, but a Voice-Enabled virtual nursing assistant can provide 24/7 support to every patient. For instance, an AI-enabled interface or virtual nurse assistant can manage multiple patient profiles simultaneously, ensuring continuous attention and care for each patient. This constant availability enhances patient monitoring, addresses queries promptly, and ensures timely medication reminders, significantly improving overall patient care and allowing human nurses to focus on more complex tasks. Patients can ask their health-related queries, and the assistant provides appropriate answers. Experimental results show that compared to traditional methods, the proposed method is more accurate and faster, allowing patients to get service anywhere and anytime.[4] A scoping review indicated that AI technologies perform multiple roles in the care of older adults and have a promising impact on elderly healthcare. These technologies show considerable potential in addressing the unmet care needs of older adults and enhancing the quality of geriatric care.[5]

Review of Literature

Some of the projects were carried out to create a voice-based smart Virtual Nursing Assistant that makes use of cutting-edge machine learning, speech recognition, and other technologies[6] Towards building a Virtual Nursing Assistant health coach an automated coaching systems have been developed with the aim of improving health coaching accessibility for millions of people who could benefit from them.[7] Chatbot software is also in trail, that can chat with people using artificial intelligence. This software is used to execute tasks such as rapidly responding to users, informing them, helping to purchase products and providing better service to customers.[8] A recent pilot project demonstrates the feasibility of deploying a consumer-grade voice assistant device in COVID-19 patient rooms, with the Echo Show device proving to be engaging and effective.[9]Among the three domains of learning outcomes—skills-based, cognitive, and affective—virtual teaching are particularly effective in enhancing cognitive outcomes, including the acquisition of theoretical knowledge.

Methodology

When an individual interacts with a Virtual Nurse Assistant (VNA) for healthcare-related information or concerns, the system captures the user's input through voice-enabled interfaces. The spoken input is processed using automatic speech recognition (ASR) technology to convert speech into text. This text is then analysed, interpreted, and semantically processed using natural language processing (NLP) techniques. The interpreted query is verified against structured and unstructured data available in the system database, including clinical

guidelines, patient records, and health knowledge repositories. Based on this analysis, machine learning algorithms generate an appropriate and context-specific response[8]. The system adapts responses by learning from user interactions, feedback, and historical data to improve accuracy over time. The validated response is then converted back into speech using text-to-speech (TTS) synthesis and delivered to the patient as a voice output. This end-to-end process enables real-time, interactive, and personalized healthcare communication, allowing patients to receive timely guidance, education, and support without direct human intervention while maintaining continuity of care.[1]

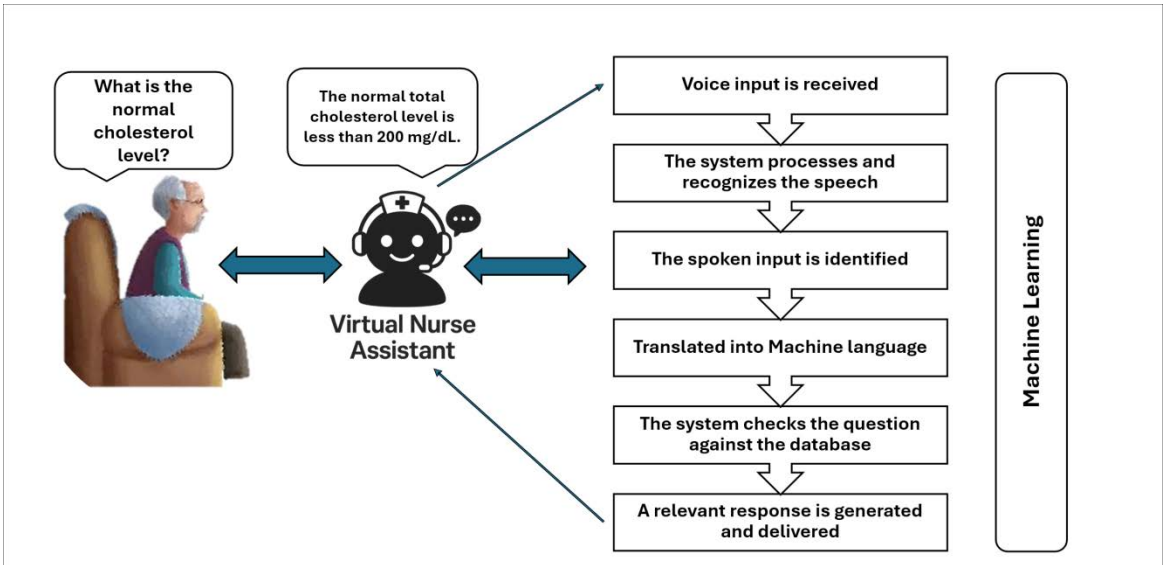

Figure 1: Communication through virtual nurse assistant (created by the author)

Benefits of Virtual Nurse assistant

The Virtual Nurse Assistant provides a wide range of benefits to both individuals and healthcare providers, from delivering personalized care to enhancing the efficiency of healthcare services.

Benefits to Individuals / Patients:

AI-powered Virtual Nursing Assistant offers personalized experiences to individuals. It helps them to identify their illness based on the symptoms, monitor their health status, schedule doctor appointments, and do more[4]. Here are some of the most valuable ways virtual nurse assistants provide support:

- **Health Guidance**
  - Analyse patient-reported symptoms to suggest possible causes and provide initial advice.
  - Recommend appropriate next steps, such as home care or medical consultation.
  - Suggest the relevant medical specialty based on symptoms.
  - Provide tailored health information on conditions like hypertension or diabetes, including side effects and when to seek medical attention.
- **Doctor Appointment and Support**
  - Simplify scheduling for doctor visits, tests, or follow-ups, including teleconsultations.
  - Send appointment reminders.
  - Answer queries regarding OPD timings, doctor availability, or specialist consultations.
- **Lab and Diagnostic Support**
  - Schedule lab tests and send timely reminders.

- Offer preparation instructions for investigations (e.g., fasting for cholesterol test).
- Explain lab results and normal value ranges to improve patient understanding.

- **Medication Management**
  - Send alerts or alarms to remind patients to take medications as prescribed.
  - Notify patients about medication refills or purchases.
  - Provide drug administration instructions (e.g., when and how to take tablets).
- **Dietary Counselling**
  - Offer personalized dietary recommendations based on health conditions.
  - Advise on foods to include or avoid for better health outcomes.
- **Chronic Condition Monitoring**
  - Regularly track vitals, symptoms, and lifestyle data in chronic conditions like diabetes or hypertension.
  - Share progress updates with healthcare providers.
  - Provide recovery tips and post-treatment monitoring for early detection of complications.
- **Emotional and Mental Health Support**
  - Detect stress, anxiety, or depression through verbal cues.
  - Provide emotional support, especially to elderly or isolated individuals.
  - Offer coping strategies and connect users with mental health professionals if necessary.
- **Insurance Reminders**
  - Inform patients about available insurance plans.
  - Send timely reminders for premium payments and policy renewals.
- **Emergency Support**
  - Respond to emergencies (e.g., chest pain or choking) by guiding immediate steps and calling ambulance services.
  - Provide instructions such as CPR guidance or first-aid tips until help arrives.

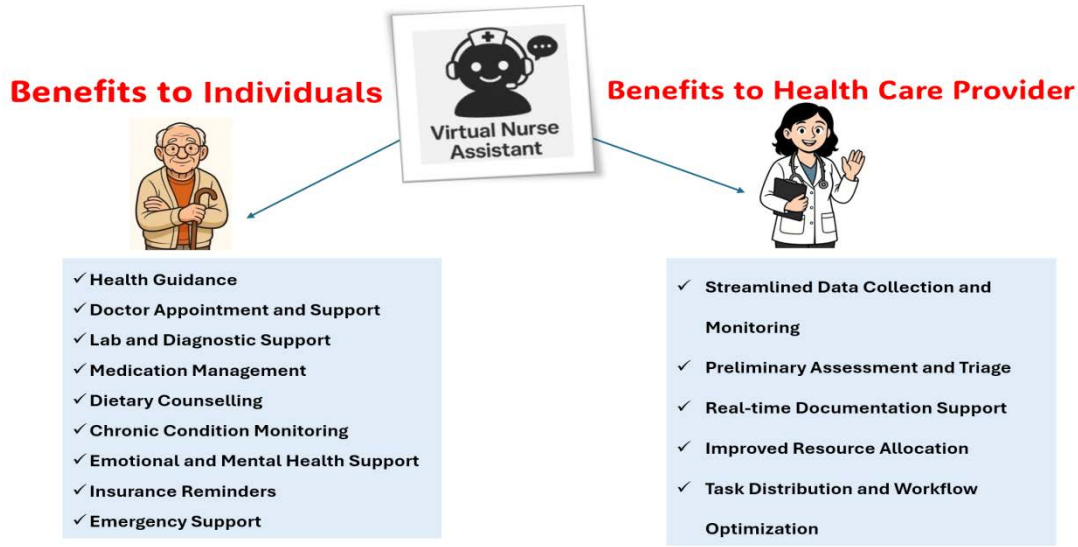

Figure 2: Benefits of Virtual Nurse assistant to Individuals and Health care Providers (created by the author)

Benefits to Healthcare Providers:

Virtual Nursing Assistants (VNAs) will support healthcare delivery by improving patient care and optimizing clinical workflows. One of the study stated that The Virtual Nursing Grand Rounds is a real-time, synchronous, computer-assisted interactive platform that supports continuous evidence-based staff development and provides expert consultative services to nursing professionals[10].Advanced technology enables the virtual nurse to oversee and coordinate patient care by engaging with patients through six core roles: patient education; staff mentoring and education; real-time quality and patient safety surveillance; participation in physician rounding; admission processes;[11]

- **Streamlined Data Collection and Monitoring**
  - VNAs efficiently gather and organize patient information, simplifying documentation and clinical consultations.
  - They enable continuous tracking of patient health metrics, trends, and improvements, providing timely alerts and insights to support informed clinical decisions.
  - Regular updates on patient progress help healthcare providers make better treatment adjustments.
- **Preliminary Assessment and Triage**
  - VNAs collect basic health histories and perform initial assessments, supporting faster diagnosis and effective treatment planning.
  - They help prioritize care by identifying urgent cases based on reported symptoms, ensuring prompt medical attention.
- **Real-time Documentation Support**
  - VNAs assist in transcribing notes during or after patient visits, allowing healthcare providers to focus more on patient interaction and care quality.
- **Improved Resource Allocation**
  - VNAs analyse collected data to predict patient needs and suggest optimal resource distribution across departments.
  - This supports better planning and preparedness, especially during peak service demand.
- **Task Distribution and Workflow Optimization**
  - VNAs help maintain an equitable distribution of tasks between nursing staff and digital assistants.
  - By handling routine and preliminary duties, they allow nurses and doctors to concentrate on complex, high-priority clinical care.

Case Studies of Voice-Enabled Virtual Nurse Assistants

Several studies have highlighted the effectiveness of Virtual Nursing Assistants in improving patient care and reducing nurses' workload. AI-driven voice agents used for monitoring daily vitals and providing medication reminders among elderly patients enhanced self-care behaviors and minimized routine nursing telephone triage[12]. At the Mayo Clinic, voice-activated systems supported patients recovering from orthopedic surgery by improving self-efficacy and reducing non-clinical inquiries to nursing staff[13]. Similarly, Cedars-Sinai Medical Centre demonstrated that in-room voice assistants handling non-medical requests saved nurses considerable time per shift[14]. Proof-of-concept studies on conversational AI for nutritional and psychological counselling in diabetic patients showed improved self-management and reduced administrative burden[15]. Additionally, voice-enabled health screening systems in low-connectivity areas enabled a single nurse to monitor larger patient populations by intervening only when critical alerts were generated[16]. Collectively, these findings emphasize the role of VNAs in enhancing efficiency, patient empowerment, and workforce optimization.

Future Prospects of Virtual Healthcare Assistants

The capabilities of VHAs are expected to expand significantly in the coming years. By 2030 advancements in AI and data analytics will enable VHAs to undertake more complex tasks, such as:

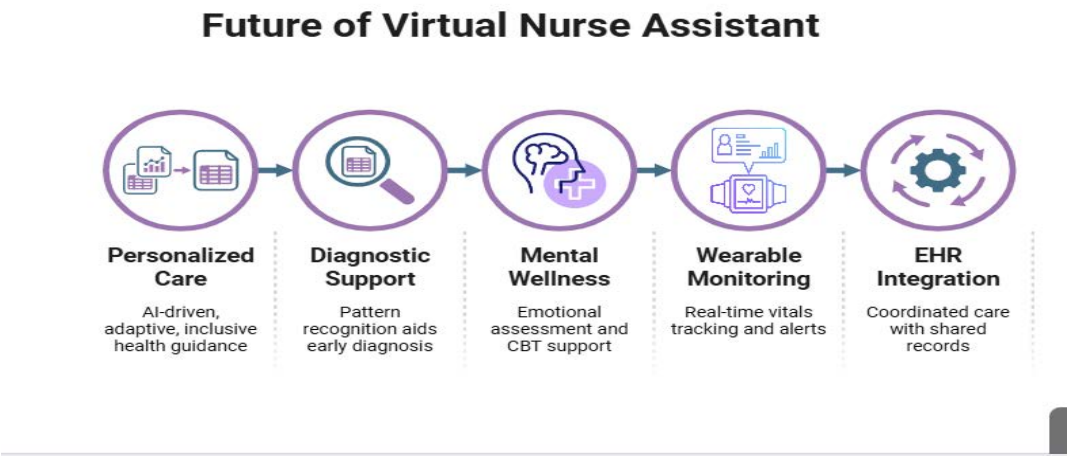

Figure 3: Future of Virtual Nurse assistant to Individuals and Health care Providers (created by the author)

- **Enhanced Personalization through AI and Patient Data**

  Virtual Nursing Assistants use artificial intelligence to deliver personalized care by analysing patients' medical history, lifestyle patterns, and ongoing feedback. They adapt health advice while considering cultural and socioeconomic factors, promoting inclusive and patient-centered healthcare1.

- **Smart Support for Diagnosis Using Symptom Patterns**

  By recognizing patterns in symptoms and health data, VNAs assist in early disease detection and recommend appropriate diagnostic tests or referrals, thereby accelerating clinical decision-making and care delivery7.

- **Virtual Mental Health Aid for Emotional Well-being**

  VNAs support emotional well-being by assessing stress and mood, offering cognitive behavioural therapy (CBT)-based modules, providing empathetic responses, and facilitating referrals to mental health professionals when required6.

- **Wearable Device Integration for Real-Time Monitoring**

  Integration with wearable devices enables VNAs to continuously track vital signs, detect physiological abnormalities, and deliver timely health guidance based on real-time patient data.

- **EHR Integration for Seamless Care**

  Synchronization with electronic health records (EHRs) allows VNAs to support coordinated and continuous care, enhance communication among healthcare providers, and reduce duplication of investigations[16].

Barriers & Challenges in implementation of Virtual Nurse Assistant

Figure 4: Barriers and Challenges of Virtual Nurse assistant (created by the author)

Protecting patient information is essential to prevent security breaches and maintain public trust, making strong yet user-friendly cybersecurity systems a necessity[17]. Virtual Nursing Assistants (VNAs) also face limitations in understanding human emotions and handling complex conversations, which can affect the quality of care[18]. In the absence of clear regulatory guidelines, the safe and legal use of VNAs remains uncertain. Poorly designed or difficult-to-use systems may discourage adoption and reduce user satisfaction. Although VNAs can be cost-effective in the long term, the high initial expenses for implementation and staff training act as a major barrier for many institutions. Gaining public confidence further requires VNAs to adhere to ethical principles such as transparency and accountability[19]. Additionally, if training data is biased or lacks adequate representation, VNAs may contribute to unequal and unjust healthcare outcomes.

The Application of Virtual Nursing Assistants in India

India currently supports a population of approximately 1.47 billion, with a life expectancy at birth of 67.3 years according to the World Health Organization (WHO)[20]. This massive demographic scale presents significant challenges for health service delivery. Although there are approximately 3.3 to 3.6 million registered nursing personnel in the country, the nurse-to-population ratio remains a critical concern. Currently, India maintains approximately 1.96 nurses per 1,000 people—with some reports suggesting even lower functional ratios of 1:476—falling well below the WHO recommended standard of 3 per 1,000[21]. This shortage is compounded by a severe geographic imbalance. Most nursing professionals are concentrated in urban centres, leaving rural and remote areas underserved. This disparity is driven by inadequate compensation, lack of professional recognition, and significant out-migration of skilled nurses[22]. In the wake of the COVID-19 pandemic, which served as a leading cause of mortality in recent years, the need for innovative supportive tools to bridge these gaps has become urgent.

In resource-constrained settings like India, VNAs can serve as valuable force-multipliers. When integrated with existing infrastructure and adapted to local cultural contexts, VNAs can enhance accessibility and continuity of care[15]. By deploying VNAs with specialized knowledge, the healthcare system can achieve a "cascade of benefits". Automating routine tasks such as appointment reminders and health education through Virtual Nursing Assistants significantly reduces the

administrative workload of human nurses, allowing them to focus more on direct patient care. VNAs also provide structured post-discharge support by ensuring regular follow-up and monitoring, which helps prevent unnecessary readmissions and promotes continuity of care. Additionally, by delivering health education in local dialects, VNAs enhance health literacy, improve patient understanding, and encourage better adherence to treatment and lifestyle recommendations.

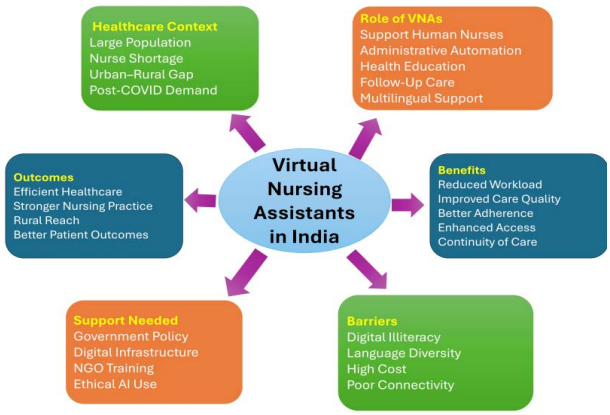

Figure 5: The Application of Virtual Nursing Assistants in India (created by the author)

Limitations and Barriers to Implementation in India

1. **The Digital Divide and Literacy:** The elderly population in India faces significant barriers to digital health. Approximately 85% of India's elderly are digitally illiterate, with only one-fifth to one-fourth utilizing internet-connected devices[23]. Barriers include the high cost of hardware, expensive data services, and a fundamental fear of technology. Furthermore, a persistent rural-urban divide exists; only 24% of rural households have internet access compared to 66% in urban areas

2. **Linguistic and Semantic Complexity:** India's linguistic landscape is incredibly diverse, encompassing over 19,500 mother tongues and 121 major languages[24]. While the Constitution recognizes 22 official languages, the development of VNAs is hindered by the need to understand local slangs, medical jargons, and regional nuances. Training AI to accurately interpret these variations is a financially demanding and technically tedious endeavour.

3. **Financial Implication:** In Tier-1 cities such as Delhi, Mumbai, and Bengaluru, the initial cost of setting up a single-room AI-powered Virtual Nursing Assistant (VNA) unit ranges from approximately ₹80,000 to ₹1,20,000, including the first year of software support. Such high upfront investment represents a substantial out-of-pocket expenditure for the general population and poses a significant financial barrier to adoption. This cost-related challenge has important implications for equitable access to digital health technologies, particularly in low- and middle-income settings, and remains one of the major obstacles to widespread implementation of VNAs[18]

VNAs are not a substitute for human nurses but act as a complementary system to strengthen nursing practice of India. Effective implementation of Virtual Nursing Assistants requires strong institutional support, including government investment in digital infrastructure and the development of clear policy frameworks to ensure ethical and responsible use of artificial intelligence. Community-level training initiatives, particularly through NGOs, can play a vital role in improving digital literacy among the elderly and other vulnerable groups, enabling them to use VNA services confidently.

Summary

Most individuals lack the medical expertise required to accurately assess or understand the seriousness of their symptoms. In this context, natural language processing plays a vital role in healthcare. AI-driven chatbots gather patient health information and use it to deliver relevant, understandable insights about physical conditions, while also guiding patients on appropriate next steps. AI-powered virtual assistant provides personalized support to patients by helping them identify possible illnesses based on symptoms, monitor their health status,

schedule doctor appointments, and perform various other healthcare-related tasks

Conclusion

A virtual nurse assistant is a digital health tool designed to support patients and healthcare providers by using artificial intelligence (AI) and machine learning (ML) technologies. The Virtual Nurse assistant services empower patients to manage their health effectively, improve treatment adherence, and access timely care, all while offering personalized and compassionate support. Nurse leaders and professional associations cite the value of virtual nursing; however, model adoption appears lower than projected need and perceived impact. Some of the study findings suggest that Virtual Nursing Assistant`s may be useful for older adults as they age in place and offer reassurance for support persons.Voice based Virtual nurse assistants represent a significant advancement in digital health, leveraging technology to enhance patient care, improve outcomes, and streamline healthcare delivery.Virtual Nursing Assistant offer an innovative way to deliver personalized, engaging, and easily accessible health programs at scale and at a low cost. The design elements of these assistants such as their visual appearance and language style play a crucial role in shaping user experience and determining how effectively users engage with them**.** Although immersive virtual reality holds promise as an educational strategy in nursing education, few studies have explored its application**.**Virtual reality is presented as a potential educational approach in nursing education, with an immersive learning experience currently being developed for nurses. However, research is required to provide multilingual support to ensure clear communication for diverse users.Furthermore, strategic deployment of VNAs should focus on health education and follow-up care, allowing human nurses to concentrate on high-acuity and complex clinical tasks, thereby improving overall healthcare efficiency and quality. With strategic planning, VNAs have the potential to play a transformative role in the future of Indian healthcare delivery.

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